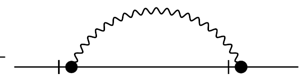
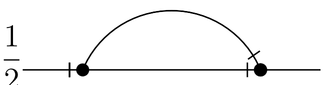
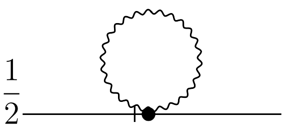
DP 1 loop graphs

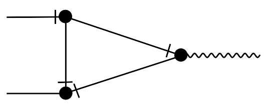
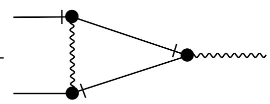
Action Functional:

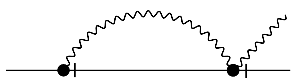
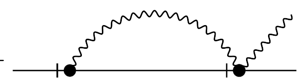
$$S_R = \psi^\dagger(-Z_1\partial_t - Z_4(\mathbf{v}\cdot\nabla) - aZ_5(\nabla\cdot\mathbf{v}) + Z_2 D\nabla^2 - Z_3 D\tau)\psi + + \frac{D\lambda}{2}\Big[Z_6(\psi^\dagger)^2\psi - Z_7\psi^\dagger\psi^2\Big] + Z_8\frac{u_2}{2D}\psi^\dagger\psi\mathbf{v}^2 - \frac{1}{2}\mathbf{v}D_v^{-1}\mathbf{v}. \quad (1)$$

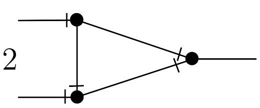
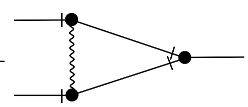
Green function in the model

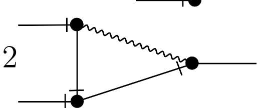
$\langle\psi^\dagger\psi\rangle_{1-ir} = i\omega Z_1 - Dp^2 Z_2 - D\tau Z_3 +$  $+$

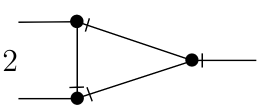
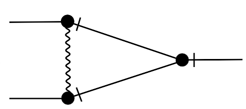
$+ \frac{1}{2}$  $+ \frac{1}{2}$  (2)

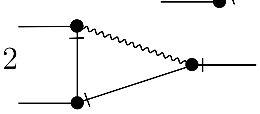
$\langle\psi^\dagger\psi\mathbf{v}\rangle_{1-ir} = -ip_j Z_4 - iaq_j Z_5 +$  $+$  $+$

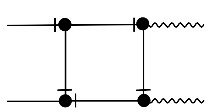
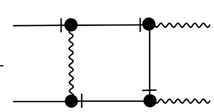
$+$  $+$  (3)

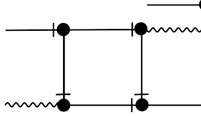
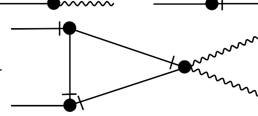
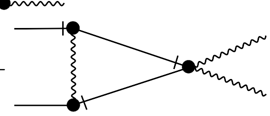
$\langle\psi^\dagger\psi^\dagger\psi\rangle_{1-ir} = D\lambda Z_6 + 2$  $+$  $+$

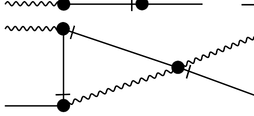
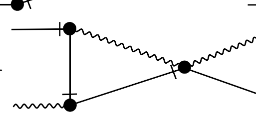
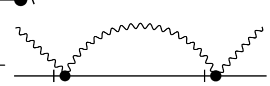
$+ \ 2$  (4)

$\langle\psi^\dagger\psi\psi\rangle_{1-ir} = -D\lambda Z_7 + 2$  $+$  $+$

$+ \ 2$  (5)

$\langle\psi^\dagger\psi\mathbf{v}^2\rangle_{1-ir} = \frac{u_2}{D}\delta_{ij}Z_8 +$  $+$  $+$

$+$  $+$  $+$  $+$

$+$  $+$  $+$ 

p - momentum of the ψ and q - momentum of the $\mathbf{v}$ in vertex $\psi^\dagger\psi\mathbf{v}$

- effective charge g_2

$$g_2 \equiv \lambda^2 \tag{6}$$

- Redefinition of charges g_1 and g_2

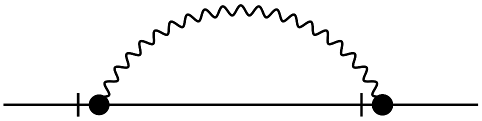
$$\frac{g_1}{16\pi^2} \to g_1 \qquad\qquad \frac{g_2}{16\pi^2} \to g_2$$

-

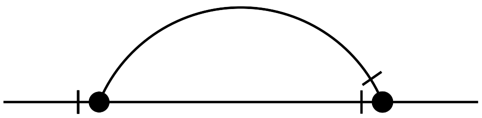
$$d = 4 - \epsilon$$

-

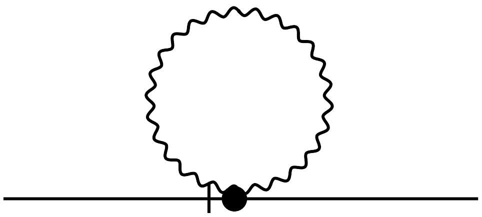
$$I_\epsilon = \frac{S_d}{(2\pi)^d} m^\epsilon \quad I_y = \frac{S_d}{(2\pi)^d} m^{-y} \tag{7}$$



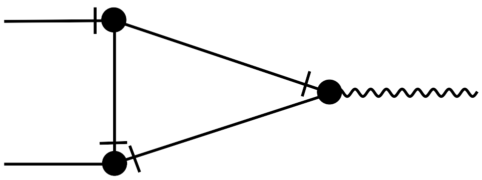
$$
\begin{aligned}
&- \quad \tfrac{g_1 D p^2 I_y}{2d(1+u_1)}\tfrac{1}{y}\left[d-1+\alpha-\tfrac{2\alpha}{1+u_1}+\tfrac{\alpha a(1-a)}{1+u_1}\left(\tfrac{4}{1+u_1}-d\right)\right] \\
&- \quad i\omega\frac{g_1\alpha a(1-a)I_y}{2(1+u_1)^2}\frac{1}{y}+\tau D\frac{g_1\alpha a(1-a)I_y}{2(1+u_1)^2}\frac{1}{y}
\end{aligned}
$$



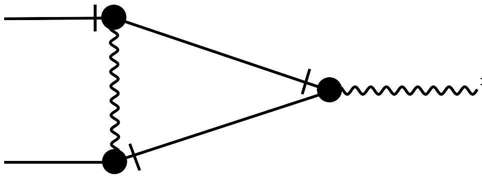
$$
=\frac{I_\epsilon}{2D}\left[\frac{i\omega}{2D}-\tau-p^2\frac{d-2}{2d}\right]\frac{1}{\epsilon}
$$



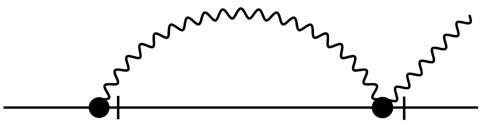
$$
=\frac{g_1 D^2(d-1+\alpha)}{2}\frac{S_d}{(2\pi)^d}\int_0^{\sqrt{\tau}\Lambda} dk \quad k^{2-y-1}
$$



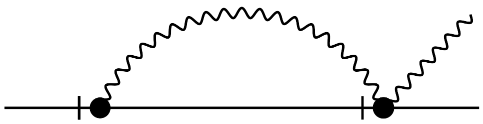
$$= \frac{-iI_\epsilon}{4dD^2}\frac{1}{\epsilon}[2p_j + q_j(ad + 3 - d)]$$



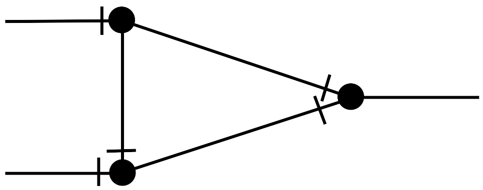
$$= \frac{ig_1\alpha I_y}{2(1+u_1)^2}\frac{1}{y}\left[(p_j + aq_j)\left(\frac{1}{d} + a - a^2\right) - \frac{2a(1-a)}{(1+u_1)d}(2p_j + q_j)\right]$$



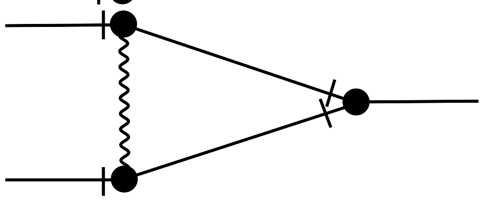
$$= -\frac{ip_j g_1 D I_y}{2d(1+u_1)}\frac{1}{y}\left[d - 1 + \alpha\left(1 - \frac{2a}{1+u_1}\right)\right]$$



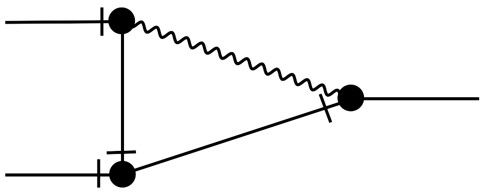
$$= -\frac{i(p_j + q_j) g_1 D I_y}{2d(1+u_1)} \frac{1}{y} \left[d - 1 + \alpha - \frac{2\alpha(1-a)}{1+u_1} \right]$$



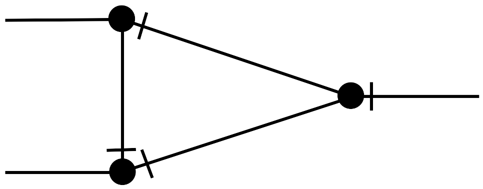
$$= \frac{I_\epsilon}{4D^2} \frac{1}{\epsilon}$$



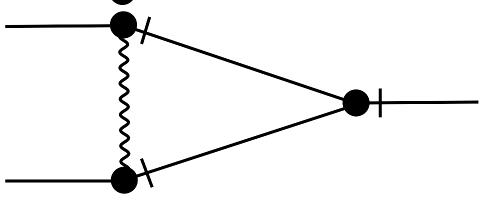
$$= \frac{\alpha g_1 I_y (1-a)^2}{2(1+u_1)} \frac{1}{y}$$



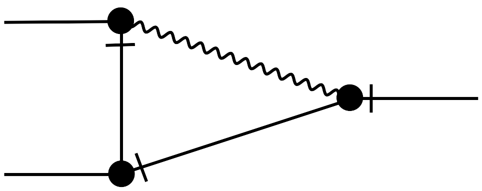
$$= -\frac{\alpha g_1 a(1-a) I_y}{2(1+u_1)^2}\frac{1}{y}$$



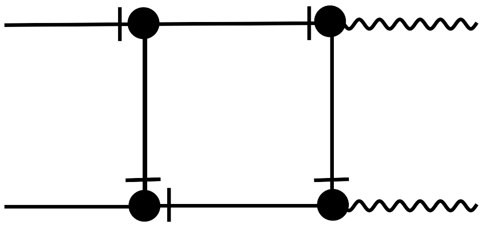
$$= \frac{I_\epsilon}{4D^2}\frac{1}{\epsilon}$$



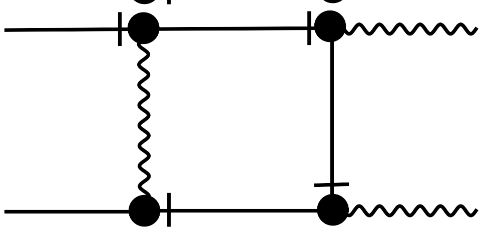
$$= \frac{g_1 \alpha a^2 I_y}{2(1+u_1)}\frac{1}{y}$$



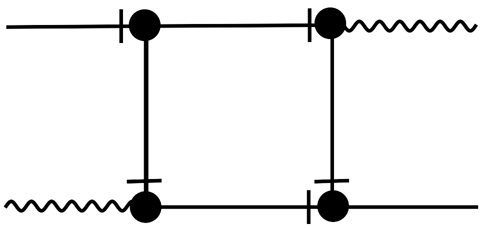
$$= -\frac{g_1 \alpha a(1-a) I_y}{2(1+u_1)^2}\frac{1}{y}$$



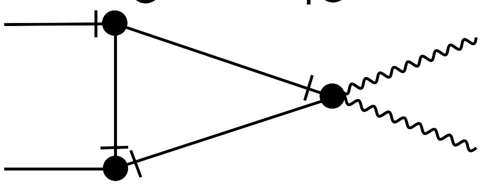
$$= -\frac{I_\epsilon \delta_{ij}}{8dD^3}\frac{1}{\epsilon}$$



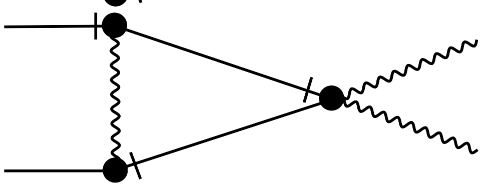
$$= \frac{g_1 \alpha a(1-a) I_y \delta_{ij}}{2d(1+u_1)^3 D}\frac{1}{y}$$



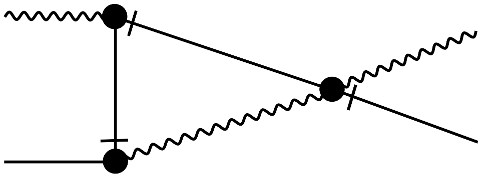
$$= \frac{I_\epsilon \delta_{ij}}{4dD^3}\frac{1}{\epsilon}$$



$$= \frac{I_\epsilon \delta_{ij}}{4D^2}\frac{1}{\epsilon}$$

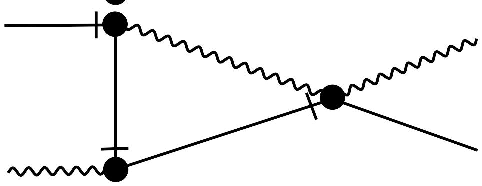


$$= -\frac{\alpha g_1 a(1-a) I_y \delta_{ij}}{2(1+u_1)^2}\frac{1}{y}$$



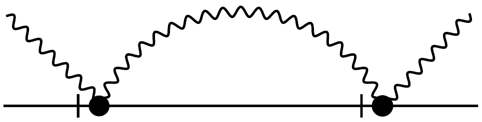
$$= -\frac{g_1 \alpha a \delta_{ij} I_y}{2d(1+u_1)^2} \frac{1}{y}$$

19.
$\psi^\dagger \psi \mathbf{v}^2$



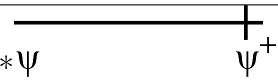
$$= -\frac{\alpha g_1 I_y (1-a) \delta_{ij}}{2d(1+u_1)^2} \frac{1}{y}$$

21.
$\psi^\dagger \psi \mathbf{v}^2$

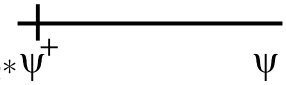


$$= \frac{g_1 D \delta_{ij} I_y}{2d(1+u_1)} \frac{1}{y} \left(d - 1 + \alpha\right)$$

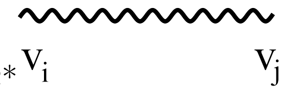
Propagators

2* 

$= \frac{1}{-i\omega + D(k^2+\tau)}$

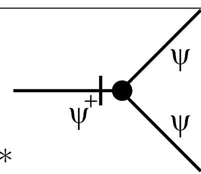
2* 

$= \frac{1}{i\omega + D(k^2+\tau)}$

2* 

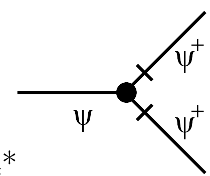
$= \frac{g_1 u_1 D^3 k^{4-d-y-\eta}}{\omega^2 + u_1^2 D^2 (k^{2-\eta})^2} (P_{ij}^k + \alpha Q_{ij}^k)$

Vertices



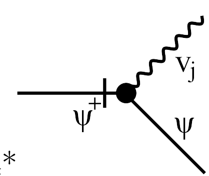
4*

2*$= -D\lambda$



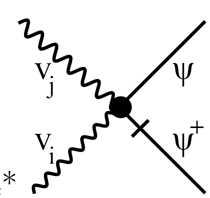
4*

2*$= D\lambda$



4*

2*$= -ip_j - iaq_j$



4*

2*$= \frac{u_2}{D}\delta_{ij}$

1. $\psi^\dagger\psi$	Vertex factor:	1
	Symmetry coefficient:	1
2. $\psi^\dagger\psi$	Vertex factor:	$-D^2\lambda^2$
	Symmetry coefficient:	$\frac{1}{2}$
3. $\psi^\dagger\psi$	Vertex factor:	$\frac{u_2}{D}\delta_{ij}$
	Symmetry coefficient:	$\frac{1}{2}$
4. $\psi^\dagger\psi\mathbf{v}$	Vertex factor:	$-D^2\lambda^2$
	Symmetry coefficient:	1
5. $\psi^\dagger\psi\mathbf{v}$	Vertex factor:	1
	Symmetry coefficient:	1
6. $\psi^\dagger\psi\mathbf{v}$	Vertex factor:	$\frac{u_2}{D}\delta_{ij}$
	Symmetry coefficient:	1
7. $\psi^\dagger\psi\mathbf{v}$	Vertex factor:	$\frac{u_2}{D}\delta_{ij}$
	Symmetry coefficient:	1
8. $(\psi^\dagger)^2\psi$	Vertex factor:	$-D^3\lambda^3$
	Symmetry coefficient:	1
9. $(\psi^\dagger)^2\psi$	Vertex factor:	$D\lambda$
	Symmetry coefficient:	1
10. $(\psi^\dagger)^2\psi$	Vertex factor:	$D\lambda$
	Symmetry coefficient:	1
11. $\psi^\dagger\psi^2$	Vertex factor:	$(D\lambda)^3$
	Symmetry coefficient:	1

$\boxed{\begin{array}{c}\text{12.}\\ \psi^\dagger\psi^2\end{array}}$

Vertex factor: $-D\lambda$
Symmetry coefficient: 1

$\boxed{\begin{array}{c}\text{13.}\\ \psi^\dagger\psi^2\end{array}}$

Vertex factor: $-D\lambda$
Symmetry coefficient: 1

$\boxed{\begin{array}{c}\text{14.}\\ \psi^\dagger\psi\mathbf{v}^2\end{array}}$

Vertex factor: $-D^2\lambda^2$
Symmetry coefficient: 1

$\boxed{\begin{array}{c}\text{15.}\\ \psi^\dagger\psi\mathbf{v}^2\end{array}}$

Vertex factor: 1
Symmetry coefficient: 1

$\boxed{\begin{array}{c}\text{16.}\\ \psi^\dagger\psi\mathbf{v}^2\end{array}}$

Vertex factor: $-D^2\lambda^2$
Symmetry coefficient: 1

$\boxed{\begin{array}{c}\text{17.}\\ \psi^\dagger\psi\mathbf{v}^2\end{array}}$

Vertex factor: $-Du_2\lambda^2\delta_{ij}$
Symmetry coefficient: 1